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PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in or relating to Glandless Motor Driven Circulating Pumps

We, HEVENT DEVELOPMENTS LIMITED, a British Company, of 17, Grosvenor Road, Southport, Lancashire, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to pumps for liquids, which pumps are capable of being used in a large number of applications including the circulation of water and central heating systems.

More particularly the invention relates to pump units or assemblies which include a rotary impeller for water or other liquid, and an electric motor for driving the impeller either through a shaft common to the motor and to the impeller, by an arrangement wherein a component of the motor is rigidly fastened to a component of the impeller, or by an arrangement wherein a single component is common to both motor and impeller.

More particularly again, the pumps of this invention are of the "glandless" type. By "glandless" we mean an arrangement whereby both the rotor of the motor and the impeller are immersed in the liquid to be pumped with some form of liquid shield positioned between the rotor and the stator of the motor completely to isolate the stator from the liquid being pumped. Such "glandless" pumps are becoming increasingly pupular on account of their silence and economy in running and their relative freedom from maintenance problems.

The motors for pumps of this type are normally of low power (usually less than 1 h.p. and not uncommonly less than 1/10th h.p.) and the dimensions of both the rotor and the stator are thus comparatively small; these factors produce certain inherent electrical disadvantages which are not to be found in other electric motors which have either or both rotors and stators of large diameters or no liquid-proof shield. The presence of the liquid-proof shield in the pump necessarily increases the gap between the internal diameter of the stator laminations and the external diameter of the rotor laminations, with the result that the magnetic field in the rotor is weaker than it would be in the case of an electric motor with no liquid-proof shield. Furthermore the necessarily small diameters of the rotor and stator in a motor of low power tend to increase still further the inefficiency of the motive force, because in such a motor the diameter of the rotor shaft is inevitably proportionately large in relation to the overall diameter of the rotor itself. This factor materially increases the significance of eddy current and hysteresis losses within the rotor shaft, and the overall problem which is always encountered in motors of this type is that of the efficiency being lower than the efficiency of a conventional electric motor in which the diameter of the rotor shaft is much smaller in relation to the overall rotor diameter.

Pumps of the glandless type can incorporate a shaft of either simple or composite construction, upon which both the rotor of the motor and the impeller are mounted in such a way that they rotate with the shaft. In such an arrangement a bearing is provided at each end of the rotating shaft; such bearings are necessarily housed in separate demountable casing components and consequently the greatest care is necessary during assembly to ensure that the correct alignment is obtained. Furthermore, it frequently happens that on account of rough handling in transit or installation, or arising out of minor dimensional changes and distortion consequent upon repeated heating and cooling, some deterioration in this alignment occurs with the result that the bearings fail.

An object of this invention is to reduce the hysteresis loss and eddy current loss in

pumps of the glandless type so as to obtain greater overall efficiency and consequently improved performance, reduction in overall size and reduction in electrical energy consumed.

In a "glandless" type pump according to this invention electrically insulating material is utilised to eliminate or minimise eddy current and hysteresis losses between the rotor and the shaft upon which it is mounted.

When the rotor is fixed on a shaft mounted in bearings at each end the electrically insulating material is conveniently in the form of a bush or sleeve interposed between the shaft, which may be of simple or compound form, and the rotor. Alternatively the shaft itself may be formed wholly or in part of electrically insulating material, which however must be suitably selected in the case of a compound shaft to have adequate strength and low surface friction characteristics.

In a preferred form of construction in which the rotor of the motor and the impeller of the pump are constructed integrally, or are rigidly fastened together and adapted to rotate on a stationary stub shaft rigidly secured to the pump housing at one end only. This provides an improved bearing arrangement which minimises the chances of the shaft and bearings coming out of alignment. A bush or sleeve of insulating material can be interposed between the integral rotor-impeller and the stub shaft. Alternatively the integral rotor-impeller may be mounted upon a tubular metal component, and in this case the sleeve or bush is preferably interposed between the rotor-impeller and the tube. Alternatively, the tube itself may be constructed of an electrically insulating material suitably chosen to have low friction characteristics or the stub shaft itself may be made wholly or in part from an electrically insulating material.

Preferably, however, a solid or tubular metallic stub shaft is used and the impeller and sleeve or bush are moulded integrally from a synthetic resinous material. Conveniently the one-piece impeller sleeve unit may be moulded from a formaldehyde polymer; preferably the rotor is mounted concentrically within a die in a moulding machine, with the result that after the moulding process the sleeve of the impeller-sleeve unit is accurately positioned within and secured to the bore of the rotor.

Whilst formaldehyde polymers have been found particularly suitable for manufacturing the one-piece impeller-sleeve unit, in general any suitable electrically insulating material, for example, thermosetting resins, thermoplastic resins, glass, mica, natural or synthetic rubber, may be used.

It is also preferable to provide the liquid proof shield for the stator by covering at least that part of it which would otherwise come into contact with the liquid being pumped with a synthetic resinous material by injection moulding, compression moulding or other convenient process. The entire stator may if it is so desired be encased with synthetic resin. Furthermore the fixed end or ends of the shaft may be moulded into the stator casing to ensure concentricity, to eliminate the possibility of liquid leakage and to reduce the assembly time. Thus by the use of injection or compression moulding techniques for both the impeller/rotor and stator units it is readily possible to produce pumps of improved performance by mass production methods.

The invention will now be described, merely by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic cross-section of a pump in which a one-piece impeller-sleeve unit is mounted upon a stationary stub shaft;

Figure 2 is a fragmentary view corresponding with part of Figure 1 and illustrating an alternative arrangement of the pump; and

Figure 3 is a fragmentary view similar to Figure 2 which shows a modified arrangement incorporating a rotating shaft.

Referring to the drawings, there are shown pumps including as the major components, an insulating bush or sleeve B, a pump impeller I, a shaft S, and a rotor R of an electric motor.

Referring first to Figure 1, the main body of the pump unit is shown by a chain dotted line and comprises two abutting resinous moulded components, viz. an electric motor housing 1 that includes encapsulated stator laminations and windings 2, and a pump housing 3 having inlet and outlet water connections 4 and 5 respectively.

The rotor R is freely rotatable within cylindrical cavity 6 provided within the motor casing. A stainless steel stub shaft S is mounted concentrically within the motor housing 1. The end of the shaft is provided with a knurled or suitably roughened surface 7 to form a key within the end 8 of the housing 1 as shown, the motor housing 1 having been moulded in position about the stub shaft 2.

The pump housing includes a central intake chamber 9 connected to the inlet water connection 4 and an annular discharge gallery 10 leading to the outlet water connections. Means, not shown, are provided to secure the two components of the main body together in a fluid-tight manner.

The rotating assembly of the pump unit comprises an integrally formed tubular member forming an insulating sleeve or bush B within the rotor R and also a multi-bladed centrifugal pump impeller I situated within the pump casing. This tubular member is manufactured from a synthetic resinous material such as "DELRIN" (Registered Trade Mark) and is preferably injection moulded into a suitable mould that is capable

of accommodating the rotor R of the electric motor. By this technique true concentricity is assured and assembly time of the rotating component is eliminated. The bore of the rotor R is suitably prepared to provide a satisfactory key between the components. The assembly is retained on the stationary stub shaft by means of a circlip 11 located within a complementary groove formed in the end of the shaft.

An alternative arrangement of a rotary component suitable for use with the above described casing is shown in Figure 2. In this example the assembly is made up from four parts that comprise a rotor R, an insulating bush or sleeve B, a metallic tube 12 and a pump impeller I. As the tube 12 is insulated from the rotor by means of the sleeve B it may be of any suitable material having the desired wearing properties; phosphor-bronze for example. Similarly a free choice of material is acceptable for the pump impeller providing that it possesses the requisite mechanical properties and anti-corrosion characteristics. From an economy aspect an injection moulded resinous material is satisfactory. It is of course essential that an adequate frictional fit or keying is provided between the respective four parts to ensure that no relative movement can take place during the operation of the pump. The interposed insulation sleeve or bush will effectively prevent eddy current losses between the rotor and stainless steel shaft on which the assembly rotates.

In the embodiment of Figure 3 the rotating component of the pump and motor are rigidly attached to the shaft which is free to rotate as a unit. It is necessary to modify the casing by the incorporation of insert bearings 13 and 14 within the pump and motor housings 3 and 8 respectively. Furthermore a longer shaft is required in this case which is suitably shouldered at each end to prevent end-float. In a manner similar to the last described example the insulating sleeve or bush B minimises eddy current loss. If it is desired it is possible to employ a combined insulating sleeve and pump impeller as shown in Figure 1. This design technique is also advantageous as far as production cost is concerned, as it is possible to form the component by injection moulding, both the rotor and the shaft being incorporated within the mould thereby to produce the entire rotary component in a single operation at low cost.

In any of the examples described the shaft may be modified either by drilling it centrally in the vicinity of the rotor still further to minimise the volume of metal contained within the magnetic field of the rotor, or by producing it from wholly or partially from an electrically insulating material.

WHAT WE CLAIM IS:—

1. A glandless electric motor-driven pump in which the rotor of the electric motor is electrically insulated from its supporting shaft

2. A pump according to claim 1 wherein the rotor shaft is rotatably mounted for rotation with the rotor, a pump impeller being mounted on the shaft and a bush or sleeve of electrically insulating material being provided between the shaft and the rotor.

3. A pump according to claim 1 wherein the rotor and the pump impeller are rotatably mounted on a fixed rotor shaft.

4. A pump according to claim 3, wherein the stationary rotor shaft is rigidly fixed at one end only to a supporting housing.

5. A pump according to claim 3 or 4, wherein the rotor shaft is metallic, a bush or sleeve of electrically insulating material being provided between the shaft and the rotor with the pump impeller being connected to said bush or sleeve.

6. A pump according to claim 3 or 4 in which the rotor shaft is metallic and carries a metallic tube which is mounted for rotation with the rotor, the pump impeller being mounted on said tube and a bush or sleeve of electrically insulating material being provided between the tube and the rotor.

7. A pump according to claim 5 or 6 in which the impeller and the bush or sleeve are formed integrally from an electrically insulating material.

8. A pump according to claims 5 and 7, wherein the impeller and the bush or sleeve have been moulded from a synthetic resinous material and located within the bore of the rotor during such moulding.

9. A pump according to claim 8 wherein the synthetic resinous material is a formaldehyde polymer.

10. A pump according to any one of the preceding claims, wherein at least that part of the stator which would otherwise come into contact with the liquid to be pumped has been covered with an electrically insulating material.

11. A pump according to claim 10, wherein the electrically insulating material is a synthetic resinous material.

12. A pump according to claim 11, wherein the synthetic resinous material is a formaldehyde polymer.

13. A pump according to claim 11 or 12, wherein the stator has been wholly or partly covered with synthetic resin during a plastics moulding process.

14. A pump according to claim 13, wherein the moulding process has resulted not only in the covering of desired parts of the stator with synthetic resin but also in the complete closure of one end only of the stator bore with synthetic resin material.

15. A pump according to claim 14 when appendant to claim 4, wherein one end of the shaft is moulded and fixed into the closed

end of the stator bore by the moulding process.

16. A pump according to claim 1, 3 or 4, wherein the rotor shaft is made from an electrically insulating material.

17. A pump according to any preceding claim wherein the rotor shaft is solid.

18. A pump according to any one of claims 1 to 16 wherein the rotor shaft is hollow.

19. Glandless electric motor driven pumps constructed and arranged substantially as herein described with reference to and as illustrated in the accompanying drawings.

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979,009 COMPLETE SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

FIG.1

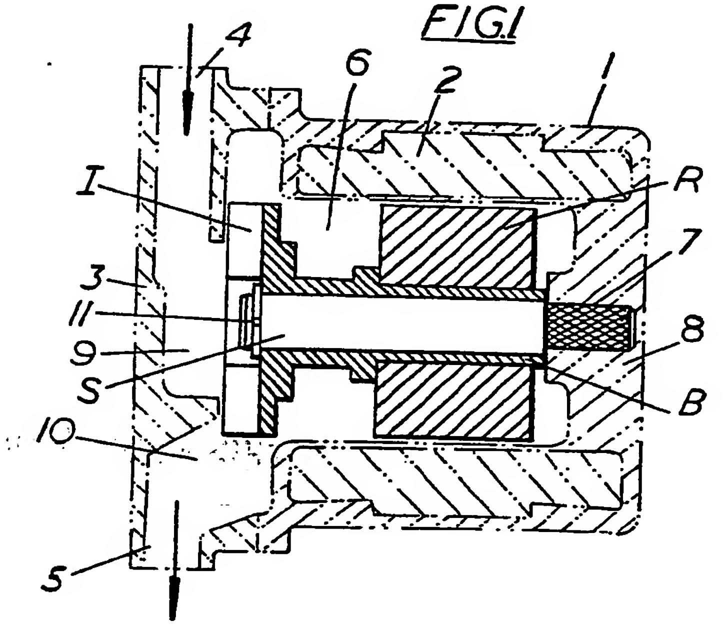

FIG.2

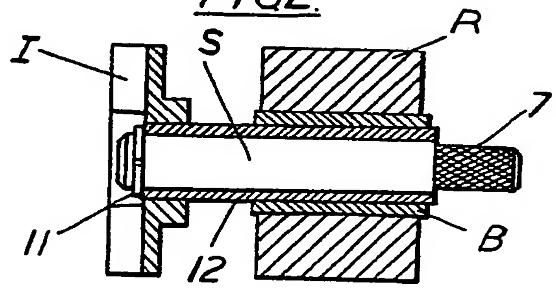

FIG.3